Sure shot question bank for students of class XII

Subject – Physics

ELECTRIC CHARGE AND ELECTRIC FIELD

1. Name the physical quantity whose S.I. unit is J/C. Is it a scalar or a vector quantity?

Ans: (i)electric potential (P.d), (ii) scalar quantity

2. How does a torque affect the dipole in an electric field?

   Ans: Torque to align the dipole along the electric field

3. What is the work done in moving a charge 10 nC Between two point on equipotential surface?
   Ans: No work is done to move charge on equipotential surface.
4. Calculate the capacity of sphere of radius of 10km.
   Ans: $C = 4\pi\varepsilon 0r = 1.1Mf$
5. Is the force acting between two point electric charges q1 and q2, kept at some distance apart in air, attractive or repulsive, when (i) $q1q2 > 0$ (ii) $q1q2 < 0$?
   Ans: (i) The force is repulsive. When $q1q2 > 0$, (ii) The force is attractive. When $q1q2 < 0$,
6. You are given three capacitors of value 2µF, 3µF, 6µF. How will you connect them to a resultant capacity of 4µF?

   Ans: 3µF, 6µF are connected in series and 2µF is connected in parallel

7. An uncharged insulated conductor A is brought near a charge insulated conductor B what happens to charge and potential of B?
   Ans: (i) charge on B conductor remain same (ii) potential of B get lowered because induces charge of opposite side of conductor A
8. Find the ratio of potential difference that must be applied across the parallel and series combination of two capacitors C1 and C2 with their capacitance in the ratio 1:3 so that the energy stored in the two cases is same.

   Ans: Given $(C1/ C2)=1/3$

   $U_P=U_S$

1/2 C_P V_P^2=1/2 C_S V_S^2
(V_P^2)/(V_S^2)=C_S/C_P Substituting CS-=(C_1 C_2)/(C_1+C_2)And Cp= C1+C2
V_P/V_S =√3/4

9. (i) Can two equipotential surfaces intersect each other? Give reasons.

(ii) Two charges −q and +q are located at points A (0, 0, −a) and B (0, 0, +a) respectively. How much work is done in moving a test charge from point P (7, 0, 0) to Q (−3, 0, 0)?

Solution:

(i) Two equipotential surfaces cannot intersect each other because when they will intersect, the electric field will have two directions, which is impossible.

(ii) Charge P moves on the perpendicular bisector of the line joining +q and −q. Hence, this perpendicular bisector is equidistant from both the charges. Thus, the potential will be same everywhere on this line. Therefore, work done will be zero.

10. A spherical Gaussian surface encloses a charge of 8.85 × 10^{-10}C.

(i) Calculate the electric flux passing through the surface.

(ii) How would the flux change if the radius of the Gaussian surface is doubled and why?

Solution:

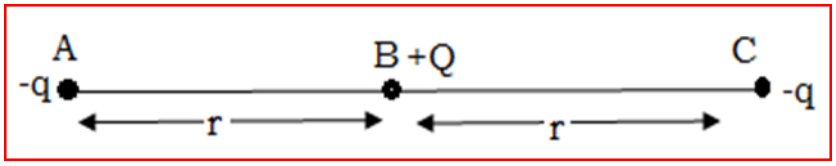
$$= \frac{q_{in}}{\varepsilon_0} = \frac{8.85\times10^{-10}}{8.85\times10^{-12}} =$$ Total flux enclosed 100 NC-1 m2

The flux would not change if the radius of Gaussian surface is double because enclosed charge remains the same.

= 100 T m^2.

11. Three charges –q, +Q and –q are placed at equal distance on a straight line. If the potential energy of the system of three charges is zero, find the ratio of Q:q

ANS As total potential energy is zero



$$\frac{1}{4\pi\epsilon_0}\left[\frac{-qQ}{r}+\frac{(-q)(-q)}{r}+\frac{Q(-q)}{r}\right]=0$$

$$-Q+\frac{q}{2}-Q=0$$

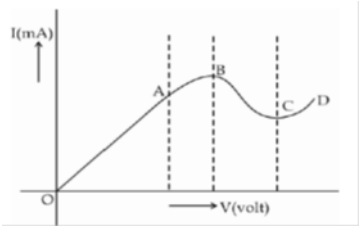
$$\left(\frac{Q}{q}=\frac{1}{4}\right)$$

Current Electricity

1. How does the drift velocity of electrons in a metallic conductor vary with increase in temperature?
   (Ans : drift velocity decrease)
2. The colours of four bands are yellow, violet, brown and gold. What is the resistance with tolerance limit.
   (Ans 470 Ω ± 5%)
3. How does the relaxation time of electron in the conductor change when temperature of the conductor decreases ?
   (ans : T α 1/τ , τ increases)
4. Two wire of equal length one copper and manganin have same resistance , which wire is thicker?

Ans: for same R and l , ρ α A => ρ menganin>ρCu => A menganin> A Cu =>menganin is thicker

5. In the given graph of voltage vs current for a semiconductor,Identify the negative resistance region.



(ans : BC region)

6. Establish a relation between current and drift velocity.

ANS- Let n = no density of free electrons current flowing in a conductor I=q/t= (neAlv_d)/(l/v_d) or I=neAv_d

7. Define resistivity of a conductor. Draw the variation of resistivity versus temperature for (i) Nichrome (ii) Silicon

Ans : Resistivity is equal to resistance of a conductor having unit length and unit cross sectional area.

8. What happens to the drift velocity (vd) of electrons and to the resistance R if length of a conductor is doubled (keeping potential difference unchanged)? Justify.
   Ans : vd halved since vd = (eτ E)/m= (eτ V)/(m l) therefor v_(d)∝1/l and R becomes four times since R= ρ l/(A)= ρ (2l)/(A/2) = 4 times of initial value
9. Draw a plot showing the variation of terminal voltage (V) vs the current (I) drawn from the cell. Using this plot, how does one determine the internal resistance of the cell ?
   Ans: V=E-Ir where E is emf of the cell. Internal resistance can be calculated by finding slope of the line.
10. Find the value of the unknown resistance X and the current drawn by the circuit from the battery if no current flows through the galvanometer. Assume the resistance per unit length of the wire is 0.01Ω cm-1.

    Ans: X/2 = (120)/80 or X=3 Ω

MOVING CHARGE AND MAGNETISM (MAGNETIC EFFECT OF CURRENT)

1. Where is the magnetic field at a current element (i) minimum and (ii) maximum?
   ANS i) Minimum - along axis
   ii) Maximum - in a plane passing throw' element and perpendicular to axis
2. Consider the circuit shown, where APB and AQB are semicircles. What will be the magnetic field at the centre C of the circular loop?
   ANS ZERO.
3. What will be the path of a charged particle moving in a uniform magnetic field at any arbitrary angle?

ANS Helical

4. In a certain arrangement, a proton does not get deflected while passing through a magnetic field region. State the condition under which it is possible.

ANS v is parallel or antiparallel to B

5. A galvanometer gives full scale deflection with the current Ig. Can it be converted into an ammeter of range I <Ig ?

ANS NO, Hint : Use S = Ig G / (I – Ig)

6. Define the term magnetic dipole moment of a current loop. Write the expression for the magnetic moment when an electron revolves at a speed 'v', around an orbit of radius ' r' in hydrogen atom

ANS Magnetic moment of a current loop:

M = NIA

i.e., magnetic moment of a current loop is the product of number of turns, current flowing in the loop and area of loop. Its direction is perpendicular to the plane of the loop.

Magnetic moment of Revolving Electron, M = evr/2

7. A wire of length L is bent round in the form of a coil having N turns of same radius. If a steady current I flows through it in a clockwise direction, find the magnitude and direction of the magnetic field produced at its centre
   ANS-

$$L = N \times 2\pi r \quad \Rightarrow \quad r = \frac{L}{2\pi N}$$

$$B = \frac{\mu_0 N I}{2r} = \frac{\mu_0 \pi N^2 I}{L}$$

8. Define current sensitivity and voltage sensitivity of a galvanometer. Increasing the current sensitivity may not necessarily increase the voltage sensitivity of a galvanometer. Justify.

ANS Current sensitivity :It is defined as the deflection of coil per unit current flowing in it.

Current Sensitivity, S=NAB/C

Voltage sensitivity: It is defined on the deflection of coil per unit potential difference across its ends.

Voltage Sensitivity, SV=NAB/GC where is resistance of galvanometer.

Justification: When number of turns N is doubled, then the current sensitivity (μN) is doubled; but at the same time, the resistance of galvanometer coil (G) will also be doubled, so voltage sensitivity Swill remain unchanged; hence increasing current sensitivity does not necessarily increase the voltage sensitivity.

9. An electron of kinetic energy 25 keV moves perpendicular to the direction of a uniform magnetic field of 0.2 milli-Tesla. Calculate the time period of rotation of the electron in the magnetic field.

ANS T= 2 π m / Bq ,

= 2x3.14 x 9.1 x10- 31 / 0.2 x 10-3 x 1.6 x 10-19

= 178.6 x 10-9 = 1.78 x 10-7 sec

10. Derive the relation between μ0 ,ε0 and c,symbols has their usual meanings.

ANS 1/4πε0= 9x 109 Nm2/C2 and (μ0)/4π =10-7Tm/A

μ0 ε0= (μ 0)/4π/1/4πε0 =10-7/9x 109 =1/(3x108)2 =1/c2

c = 1/√μ0 ε0

ELECTRO MAGNETIC INDUCTION

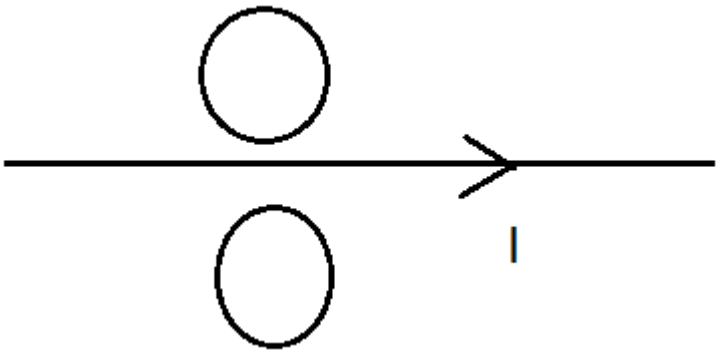
Q1. Define the term self-inductance of a coil. Give its SI unit.

Ans. The self-inductance L is defined as the emf induced in the coil, when the rate of change of current in that coil is 1 A/s.

Q2.If the rate of change of current is 2 ampere/second in a solenoid induces an emf of 40mV in the solenoid, what is the self-inductance of this solenoid?

Ans. L= - e/(dI/dt) = = 20X 10-3 H = 20mH

Q3.Predict the directions of induced currents in metal rings 1 and 2 lying in the same plane where current I in the wire is increasing steadily.



Ans Above the wire in the ring clockwise

Below the wire in the ring anticlockwise

Q4. State Lenz's law in electromagnetic induction.

Ans. The direction of induced current in a closed circuit is always such that it opposes the cause that produces it.

Q5. Write the expression of electromagnetic energy stored in an inductor of inductance L when steady current is passed through it.

Ans. $U = 1/2\ LI^2$.

Q6.Two circular loops are placed with their centres at fixed distance apart. How would you orient the loops to have (i) maximum (ii) minimum Mutual inductance?

Ans. (i)For maximum mutual induction the orientation should be parallel

(ii) For minimum the orientation should be perpendicular.

Q7.Define eddy current. Give one application of eddy current

The induced currents in the solid conductor due to the motion of the conductor in the magnetic field

Electromagnetic Damping, Magnetic breaks

Q8.What is magnetic flux? Write its expression and SI unit.

Ans. The total no of magnetic field lines through a closed surface is called magnetic flux.

$\Phi = B.dA$

SI unit of magnetic flux is weber.

DUAL NATURE OF MATTER AND RADIATION.

1. The wavelength of electromagnetic radiation is doubled. What will happen to the energy of photon?

Ans : It becomes half. ($E = hc/\lambda$)

2. Ultraviolet light is incident on two photosensitive materials having work function $\varphi 1$ & $\varphi 2$ ($\varphi 1 > \varphi 2$). In which of the case will K.E. of emitted electrons be grater? Why?

Ans : Material having work function $\varphi 2$ has greater Kinetic energy. ($K = hv - \varphi 0$)

3. An increase in the intensity of incident light does not change the maximum velocity of the emitted photo electrons. Why?

Ans: Kinetic energy is independent of intensity of incident light. Hence no change in velocity.

4. The stopping potential in an experiment on photoelectric effect is 1.6 volt.what is the maximum kinetic energy of the photoelectrons emitted?.

Ans: $K = eV0 = 1.6$ eV

5. Name the experiment which verified the wave nature of particles.

Ans :Devison and Germer experiment.

6. What is the stopping potential applied to a photocell if the maximum kinetic energy of a photoelectron is 5eV?

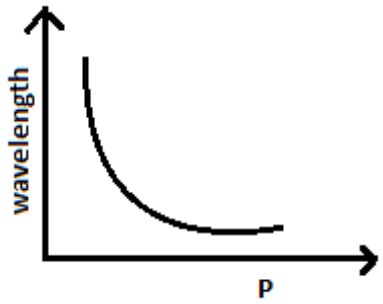
Ans: K.E.=eV_o and 5eV= eV_o

V_o =5 volt(negative)

7. Define threshold wavelength.

Ans: maximum wavelength of the incident radiation above which no photoelectric emission is possible.

8. Show graphically, the variation of de-Broglie wavelength (λ)with the momentum of an electron.



9. An α-particle and a proton are accelerated from rest by the same potential. Find the ratio of their de-Broglie wavelengths.

Ans = Since de Broglie wavelength λ ∝ 1/√(m q) or λ_α/λ_p = √((m_pq_p)/(m_α q_α))= 1/√8

10. The two lines A and B shown in the graph plot the de-Broglie wavelength λ as function of 1/√V (V is the accelerating potential) for two particles having the same charge. Which of the two represents the particle of heavier mass?

Ans: Since λ= 1/√(2m q) 1/√V (slope= 1/√(2m q)) therefore higher the slope smaller the mass .Mass B is heavier.

11. Deduce de Broglie wavelength of electron accelerated by potential of V volt.Expression for de- Broglie wavelength associated with Accelerated Electron:

The de Broglie wavelength associated with electron of momentum p is given by

λ=h/p=h/mv ….(i)

Where m is the mass and v is velocity of electron. If E_k is the kinetic energy of electron, then

E_k=1/2 mv^2=1/2 m(p¦m)^2=p^2/2m (since p=mv⟹v=p/m)

$\Longrightarrow p=\sqrt{(2mE_k)}$

$\therefore$ Equation (ii) gives $\lambda=h/\sqrt{(2mE_k)}$ …(ii)

If V volt is accelerating potential of electron, then kinetic energy,

$E_k=eV$

$\therefore$ Equation (ii) gives $\lambda=h/\sqrt{2meV}$ …(iii)

Semiconductordevices and communication system

1. On what factors does the conductivity of metal depend?

Ans. (i) No. of free electrons (ii) drift velocity

2. What is energy band?

Ans. Group of large No. of energy levels lying very close to each other.

3. Where are donor & acceptor levels located in a semiconductor?

Ans. Donor level just below the conduction band whereas acceptor level just above the top of the valence band.

4. What is the value of potential barrier for a (i) Ge diode & (ii) Si diode

Ans. Ge = 0.3V & for Si = 0.7V

5. What is Zener breakdown?

Ans. When a sufficient high reverse voltage is applied across the p-h State any one difference between half wave rectifier & full wave rectifier?

6. What is the relation between α & β?

Ans. $\alpha=\beta/(1+\beta)$

7. What is phase relationship between input & output voltages of a C.B. amplifier & C.E. amplifier?

Ans. (i) are in phase (ii) differ in phase b y180º

8. Why is germanium preferred over silicon for making semiconductor devices?

Ans. Eg for Ge = 0.7 eV is smaller than Eg for Si = 1.1eV.

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10. Why is p-n junction also called a junction diode?

Ans. Its unidirectional property is similar to that vacuum diode.

11. What are intrinsic and extrinsic semiconductors. How many types of extrinsic semiconductor are there.

Ans. Intrinsic semiconductors are pure semiconductors .Extrinsic semiconductors are those pure semiconductors that have been doped with impurity. two types of extrinsic semiconductors are P type and N type.

12. Which of the transistors p-n-p & n-p-n is more useful?

Ans.n-p-n because electrons have higher mobility than holes.

13. In a transistor connected on C.E. mode Rc = 4kΩ, Ri =1kΩ, Ic = 1mA &Ib =20μA. Find the voltage gain?

Ans. Av= β Rc/Ri=200

14. In a n-p-n transistor the collector current is 10mA. If 90% of electrons emitted reach the collector find base and emitter current?

Ans. Ie=10/90 x100=11.11mA ,Ib=1.11mA

15. the output of an OR gate is connected to both the inputs of NAND gate write its tooth table.

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

COMMUNICATION SYSTEM

1. Which basic modes of communication are used for telephonic communication?

Ans. point to point communication

2. what is change in amplitude modulation?

Ans. Amplitude of high frequency carrier wave is made proportional to the instantaneous amplitude of audio frequency modulating voltage.

3. What is meaning of the term 'attenuation' used in communication system?

Ans. Loss of strength of a signal while propagating through medium.

4. What is the full form of 'GPS'?

Ans. Global positing system

5. Arrange the following network in increasing order of the number of computers that may be present in the network:Internet; LAN; WAN

Ans: LAN,WAN and Internet

6. A TV tower has a height of 71 m. What is the maximum distance up to which TV transmission can be received? Given that the radius of the earth = 6.4 × 106 m.

Solution:

We know that: $d_M = \sqrt{2Rh_T} + \sqrt{2Rh_R}$

Where,

D_m = Maximum distance between the transmitting and receiving antenna

H_t = Height of transmitting antenna

Therefore,

$$d_M = \sqrt{2Rh_T} = \sqrt{2 \times 6.4 \times 10^6 \times 71} = 30146 \text{ m}$$

Hence, the maximum distance up to which TV transmission can be received is 30146 m.

7. Explain why high frequency carrier waves are needed for effective transmission of signal. A message signal of 12 KHz and peak voltage 20 V is used to modulate a carrier wave of frequency 12 MHz and peak voltage 30 V. Calculate the (i) modulation index (ii) side-band frequencies.

Solution:

For the effective transmission of signals, the high frequency carrier waves are used because these high frequency carrier waves travel through space or medium with the speed of light and they are not obstructed by earth's atmosphere.

Numerical: Here, Vm = 12 KHz, Em = 20 V

Vc = 12 MHz = 1200 KHz, Ec = 30 V

(i) Modulation index,

(ii) The side bands are:

USB = Vc + Vm = 12000 + 12 = 12012 KHz

LSB = Vc + Vm = 12000 − 12 = 11988 KHz

8. What is the range of frequencies used in satellite communication? What is common between these waves and light waves?

Solution:

The waves used for satellite communication lie in the following two frequency ranges.

(i) 3.7−4.2 GHz for downlink

(ii) 5.9−6.4 GHz for uplink

The waves used for satellite communication and light waves are both electromagnetic waves. Both of them travel in a straight line.

9. What is ground wave communication? On what factors does the maximum range of propagation in this mode depend?

Solution:When the radio waves from the transmitting antenna propagate along the surface of the earth to reach the receiving antenna, it is called ground wave communication. For this type of communication, the frequency range is less than a few MHz. The maximum range depends on the absorption of energy by the earth and also on the initial transmitting power.

Write the functions of the following in communication systems:

(i) Transducer

(ii) Repeater

Solution:

(i) Transducer: A transducer is used to convert a non-electrical signal like a voice signal into electrical form before sending it as an input to a transmitter.

(ii) Repeater: A repeater is a combination of a receiver and a transmitter. It picks up the signal from a transmitter, amplifies it and retransmits it. A repeater is mainly used to extend the range of a communication system.

OPTICS

1. An object is held at the principal focus of a concave lens of focal length *f*. Where is the image formed?

Ans: That is image will be formed between optical centre and focus of lens; towards the side of the object.

2. What is the geometrical shape of the wavefront when a plane wave passes through a convex lens?

Ans: The wavefront is spherical of decreasing radius.

3. A diverging lens of focal length 'F' is cut into two identical parts each forming a plano-concave lens. What is the focal length of each part?

Ans: Focal length of each half part will be **twice the** focal length of initial diverging lens.

4. How the angular separation of interference fringes in Young's double slit experiment change when the distance between the slits and screen is doubled?

Ans: Angular separation between fringes, $\beta_\theta = \lambda/d$where λ = wavelength, *d* = separation between coherent sources. So, β_θ is independent ofdistance between the slits and screen. So angular separation (β_θ) will remain unchanged.

5. Two thin lenses of power +6 D and – 2 D are in contact. What is the focal length of the combination?

Ans: Net power of lens combination P =P_1 + P_2= + 6 D - 2 D = + 4 D
∴ Focal length, f = 1/P = ¼ m = 25 cm

6. Two thin lenses of power +5 D and –2.5 D are in contact. What is the focal length of the combination?

Ans: Net power of lens combination, P = P_1 + P_2 = + 5 - 2.5 = + 2.5 D
∴Focal length, f = 1/P = 1 / 2.5 = 0.4m = 40cm

7. A converging lens is kept co-axially in contact with a diverging lens – both the lenses being of equal focal lengths. What is the focal length of the combination?

Ans: Let focal length of converging and diverging lenses be + f and - f respectively.
Power of converging lens P_1 = 1/f and Power of diverging lens P_2= - 1/f
∴Power of combination P = P_1 + P_2= 1/f - 1/f = 0
∴Focal length of combination f = 1/P = 1/0 = ∞

8. When light travels from a rarer to a denser medium, the speed decreases. Does this decrease in
speed imply a decrease in the energy carried by the light wave? Justify your answer.

Ans: No; when light travels from a rarer to denser medium, its frequency remains unchanged.According to quantum theory, the energy of a light beam depends on frequency and not on speed.

9. How does the angular separation between fringes in single-slit diffraction experiment change when the distance of separation between the slit and screen is doubled?

Ans: Angular separation is θ = β / D = λ / d
Since θis independent of *D*, angular separation would remain same.

10. For the same value of angle incidence, the angles of refraction in three media *A*, *B* and C are 15°,25° and 35° respectively. In which medium would the velocity of light be minimum?

Ans: From Snell's law,n = sin i/sin r = c/v
For given i,v ∝ sin r ;r is minimum in medium A, so velocity of light is minimum in medium A.

11. In a single-slit diffraction experiment, the width of the slit is made double the original width. How
does this affect the size and intensity of the central diffraction band?

Ans: In single slit diffraction experiment fringe width is, $\beta = 2D\lambda / d$
If *d* is doubled, the width of central maxima is halved. Thus size of central maxima is reduced tohalf. Intensity of diffraction pattern varies square of slit width. So, when the slit gets double, itmakes the intensity four times.

12. How does the fringe width, in Young's double-slit experiment, change when the distance ofseparation between the slits and screen is doubled?

Ans: The fringe width is, $\beta = D\lambda / d$
If D(distance between slits and screen) is doubled, then fringe width will be doubled.

13. Draw a labeled ray diagram to show the image formation in a refracting type astronomical telescope. Why should the diameter of the objective of a telescope be large?

14. Define resolving power of a compound microscope. How does the resolving power of a compound microscope change when
    (i) Refractive index of the medium between the object and objective lens increases?
    (ii) Wavelength of the radiation used is increased?

    ANS- Resolving power of a microscope is defined as the reciprocal of the minimum separation of two points seen distinctly.

    Resolving power = $2 n \sin\theta / 1.22 \lambda$

    1. Increase in the refractive index (n) of the medium increases resolving power because RP∝n
    2. On increasing the wavelength of the radiation, resolving power decreases because RP $\propto 1/\lambda$

15. Define resolving power of a telescope. How does it get affected on
    (i) Increasing the aperture of the objective lens?
    (iii) Increasing the focal length of the objective lens?

    ANS: Resolving power of a telescope is defined as the reciprocal of the smallest angular separation between two distant objects.

    Resolving power = $D / 1.22 \lambda$ where D is aperture of the objective lens

    1. Resolving power increases on increasing the aperture of the objective lens, since RP ∝D.
    2. Resolving power does not get affected on increasing the focal length of objective lens, since RP is independent of focal length.